Failure Analysis of Insulated Sheet Metal Siding Following An MSLB in The Steam and Feedline Penetration Area Indian Point Unit 3

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I. Introduction

In an SER dated December 30, 1982 on Environmental Qualification of Electric Equipment Important to Safety for Indian Point Unit 3, the NRC stated that analyses which were submitted by NYPA to NRC were not accepted by the staff for the pressure/temperature service conditions outside on containment.

One of the areas questioned by the NRC staff was the steam and feedline penetration area.

A. Description of the Steam and Feedline Penetration Area

The steam and feedline penetration area is a building located on the West side of the reactor containment building which houses the main steam and feedwater piping and associated isolation valves, safety valves, and supports. The building consists of a concrete shield wall at the West end (which provides biological shielding for streaming paths associated with the containment penetrations for the steam and feedwater pipes) and a steel structure covered with insulated metal siding on the North and South ends. Figure 1 shows the configuration of the building exterior.

B. Effects of a High Energy Line Break (HELB) in the Steam and Feedline Penetration Area

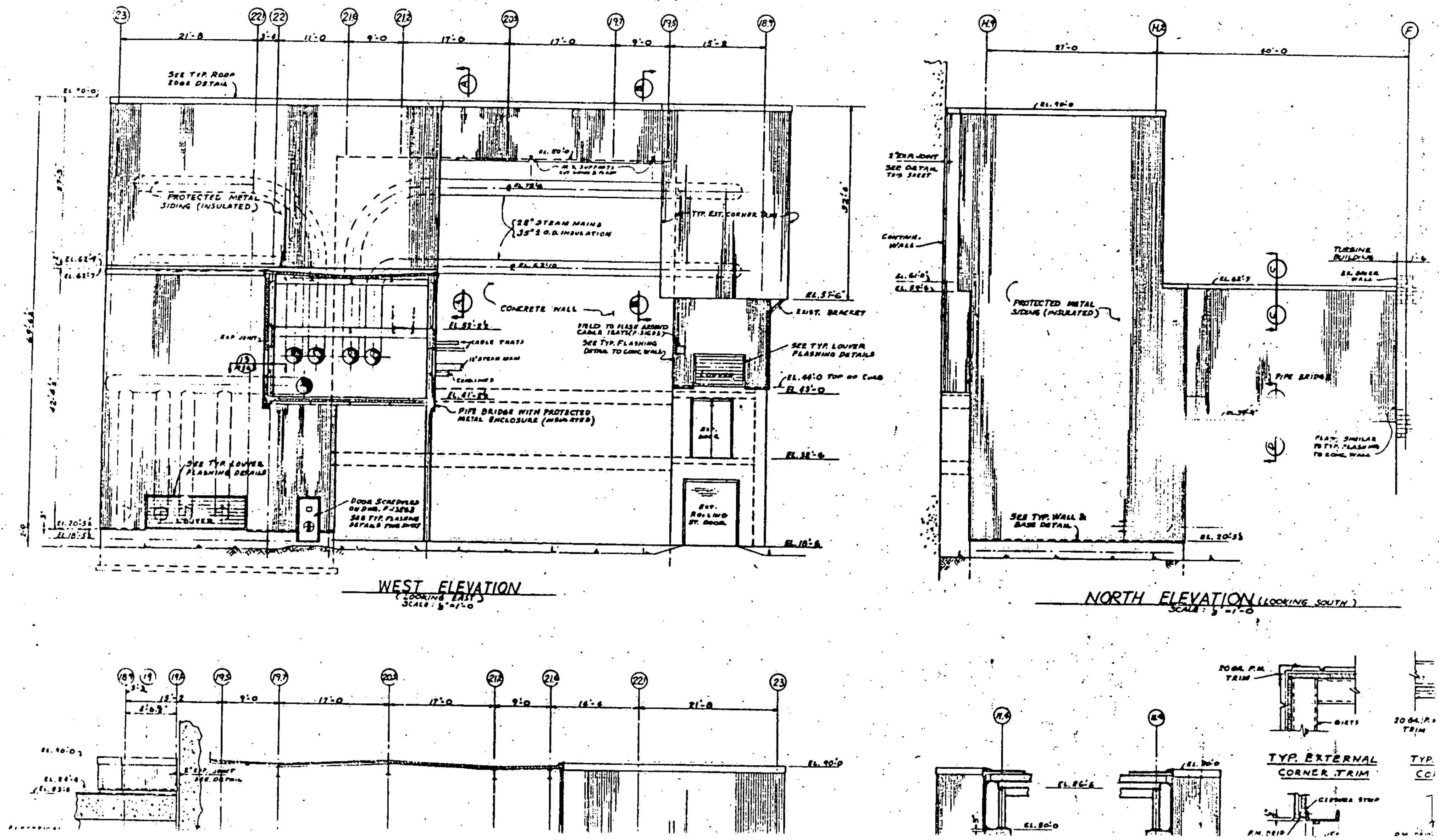
In the analysis of high energy lines for Indian Point Unit 3 dated May 9, 1973, it was stated that no significant temperature build-up could occur due to the low pressure differential at which the siding panels fail and that temperature buildup would not be significant since the siding would blow off almost immediately following a break. This information was reaffirmed by NYPA in the May 1983 submittal to NRC pursuant to 10CFR50.49.

During a meeting among NYPA and NRC staff representatives on April 25, 1984, it was determined that the COBREE analysis performed by NRC did not consider that the siding would rupture and vent the steam to atmosphere. NYPA indicated that the siding is designed for only a 60 psf (.42 psig) loading and that the failure of the siding would preclude any temperature or pressure buildup in the steam and feedline penetration area. As a result of the discussions, the staff requested NYPA to provide an analysis which confirms that the siding would fail and vent steam to atmosphere in the event of a HELB in the steam and feedline penetration area thereby confirming that there would be no significant pressure and temperature buildup.

C. Purpose of this Report

This report contains the results of an analysis of the effects of a pressure buildup in the steam and feedline penetration area to determine the pressure at which the insulated sheet metal siding would fail and vent the steam to the atmosphere. The analysis uses the GT-STRUDL finite element analysis program which was selected because the program is suitable for structural analysis for Nuclear Power Plants and Quality Assurance is maintained by Control Data Corporation for the Cybernet System.

FOR INFORMATION ONLY



I. Software Description

The Integrated Computer Engineering System (ICES) Structural Design Language (STRUDL) is a computer software package used for structural analysis and design. The version employed in this analysis was developed by the Georgia Institute of Technology, and hence the package is usually referred to as GTSTRUDL.

GTSTRUDL allows the user to specify characteristics of structural problems, perform analyses, reduce and combine results, perform designs, and output any part, or all of the information stored in the structural problem data base on a selective basis.

External influences resulting from applied forces, temperature, initial strain (fabrication error), or specified joint displacements (support movement) may be considered to act separately or in any combination as independent loading conditions.

GTSTRUDL analysis procedures perform linear small displacement static and dynamic analyses of structures composed of any combination of members and finite elements with the same or variable number of degrees of freedom per joint. In addition, non-linear geometric and material (large displacement/small strain) static analyses of framed structures may be performed.

Output may be requested by the user in a variety of formats and in any quantity desired. Output may include input data, joint displacements, support reactions, member end forces and distortions, member force, stress and envelope diagrams at any number of points along a member, element stresses and strains, statics check results, etc. Output may be ordered by loading condition, member, element, or joint, and may be requested for one or more combinations of joints, members, elements, and loading conditions (independent and/or dependent).

Software Description (cont'd)

The structural engineer is not required to have any prior knowledge of computers, computer operation, or computer programming in order to analyze and design simple or complex structures. Instead, by using GTSTRUDL, the engineer simply communicates the characteristics of the problem, and procedures to be applied to its solution, by using an English-like Problem-Oriented-Language (POL). The POL is computer independent, easily used and understandable to an engineer, and reflects the terminology a structural engineer would normally use when discussing a problem solution with his colleagues. The POL of GTSTRUDL permits the engineer to dictate his particular problem solving needs to the computer, rather than having to conform to arbitrary computer program requirements. The goal of the POL is to permit the engineer to maintain and exercise his role as decision maker when using computers for structural analysis and design.

The above discussion represents the broadest possible description of the GTSTRUDL Software. A complete description can be found in the GTSTRUDL USER INFORMATION MANUAL (Reference 4).

III. Description of Computer Model

The computer model used to solve the problem described in the introduction uses a thin plate, fixed support model to represent the PLASTEEL C-3 siding section* which covers the exterior of the building structural frame. The particular span that was analyzed is that section which covers the widest structural span. This siding section is considered to be the limiting case because the failure resulting from the loading conditions will produce the maximum venting area for the steam conditions.

The largest span in the building without intermediate support is 19 feet high and 21 feet 8 inches wide. The siding is totally supported by the fasteners between the section liner and the main girts (Interface 1).

In order to model the siding section and determine what pressure load will cause the siding section to fail, it was first necessary to obtain information regarding the materials of construction, method of assembly, and other design data. Enclosure 1 was the information received from the PLASTEEL PRODUCTS CORPORATION.

This information provides both failure information (ultimate capacities) and design limits (safe spans, etc.).

The siding section under consideration is manufactured with a sandwich-type construction. As shown in PLASTEEL drawing L2V-C3 (See Enclosure 1), the section is composed of a vertically corrugated steel cover fastened to horizontal sub-girts (Interface 3). The subgirts are attached to a steel liner (Interface 2). The liner is mounted to the main girts or other structural support members (Interface 1). Insulation fills the space between the liner and cover. Each 24 in. section is fastened to the previous section until the desired width is achieved.

Enclosure 1 contains the information supplied by the siding manufacturer. The following data were obtained from that information:

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*See Enclosure 1 for panel description.

Liner - #20 gage steel
24 in. wide (nominal)
0.0359 in. thickness
1.78128 lb/ft^2

Cover - #22 gage steel
24 in. wide (nominal)
0.0299 in. thickness
1.81902 lb/ft^2

Sub-girt - #20 gage steel
2.5 in. wide (hat-shaped section)
0.0359 in. thickness

Fastener: (Ultimate Strength)
Interface 1 - 1500# (Pull Over-Liner Shearing)
Interface 2 - 800# (Pull-Out)
Interface 3 - 500# (Pull-Out)

The manufacturer's information states that the perimeter fasteners are spaced every 12 inches and that sub-girts are spaced vertically every 16 inches.

PLASTEEL has verified the fastener data and their predicted safe spans with testing. They also stated that a similar C-3 siding section actually failed under steam line break conditions at Fort Martin Station in Virginia, an Allegheny Power Corporation facility.

The possible failure modes to consider are:

1. "Pull-Over" - The liner actually pulls over (shears) the fastener and washer.
2. "Pull-Out" - The fastener is pulled through the material it was joining.
3. "Shear-Out" - The liner tears out perpendicular to the axis of the fastener.

IIIA. Justification for Use of Steel Plate Model

In order to model this complex siding section as a thin steel plate, a simplifying analysis is necessary.

1. Plate

The most important parameter involved in determining the equivalence of using a steel plate to model the siding section is the area moment of inertia (I) about the horizontal or x-axis (see Figure A).

In order to produce a similar physical response to a particular loading condition, the rigidity of the model must approximate the rigidity of the siding section. The rigidity of the siding section is greatest about the x-axis because the corrugations run vertically. The rigidity about the y-axis is less for the siding section; however, for the steel plate Ix = Iy. To determine the equivalent thickness of the steel plate with equal rigidity, Ix for the siding section will be determined and equated to Ix for the steel plate. No credit is taken for the sub-girts in calculating Ix because they provide no rigidity against bending about the x-axis.

This approach produces smaller deflections in the model than would actually occur in the siding section due to the smaller value of Iy for the siding section. Smaller deflections translate to less strain, lower stresses and bending moments, and, consequently, higher pressure loads before failure occurs.

2. Moment of Interia

Liner: The liner is flat except for the ends. The centroid will be considered to be concentrated in the center of the flat section, though the entire area will be used to calculate Ix_1. This will yield a higher value of Ix_1.

$$Ix^*_{L_c} = \frac{wt^3}{12} = \frac{(24 = 4.75)\ (0.0359)^3}{12} = 1.33 \times 10^{-3}\ in^4$$

2. Moment of Interia (cont'd)

where: W** = 28.75 in; t = 0.0359

$A = (W)(t)$

$A = (28.75)(0.0359) = 1.032125 \text{ in}^2$

$d = 1.375 + .25 = 1.625 \text{ in.}$

$Ix_4{}^* = Ix_{1_c} + Ad^2$

and:

$Ix_L = 1.33 \times 10^{-3} + (1.032125)(1.625)^2$

$Ix_L = 1.33 \times 10^{-3} + 2.72545$

$Ix_L = 2.72678 \text{ in}^4$

$$Ix_{f_c} = \frac{wt^3}{12} = \frac{(33.5)(0.0299)}{12} = 7.46 \times 10^{-5} \text{ in}^4$$

where: W**= 33.5 in; t = 0.0299 in.

$Ix_f = If_{2_c} + Ad^2$

and:

$A = (W)(t)$

$A = (33.5)(0.0299) = 1.00165 \text{ in}^2$

$d = 1.625 \text{ in.}$

$I_{X_2} = 7.46 \times 10^{-5} + (1.00165)(1.625)^2$

$= 7.46 \times 10^{-5} + 2.64498$

$= 2.64505 \text{ in}^4$

* Figures B and C show the diagram for calculating the Moment of Interia for these sections.

** Equivalent lengths include all corrugations.

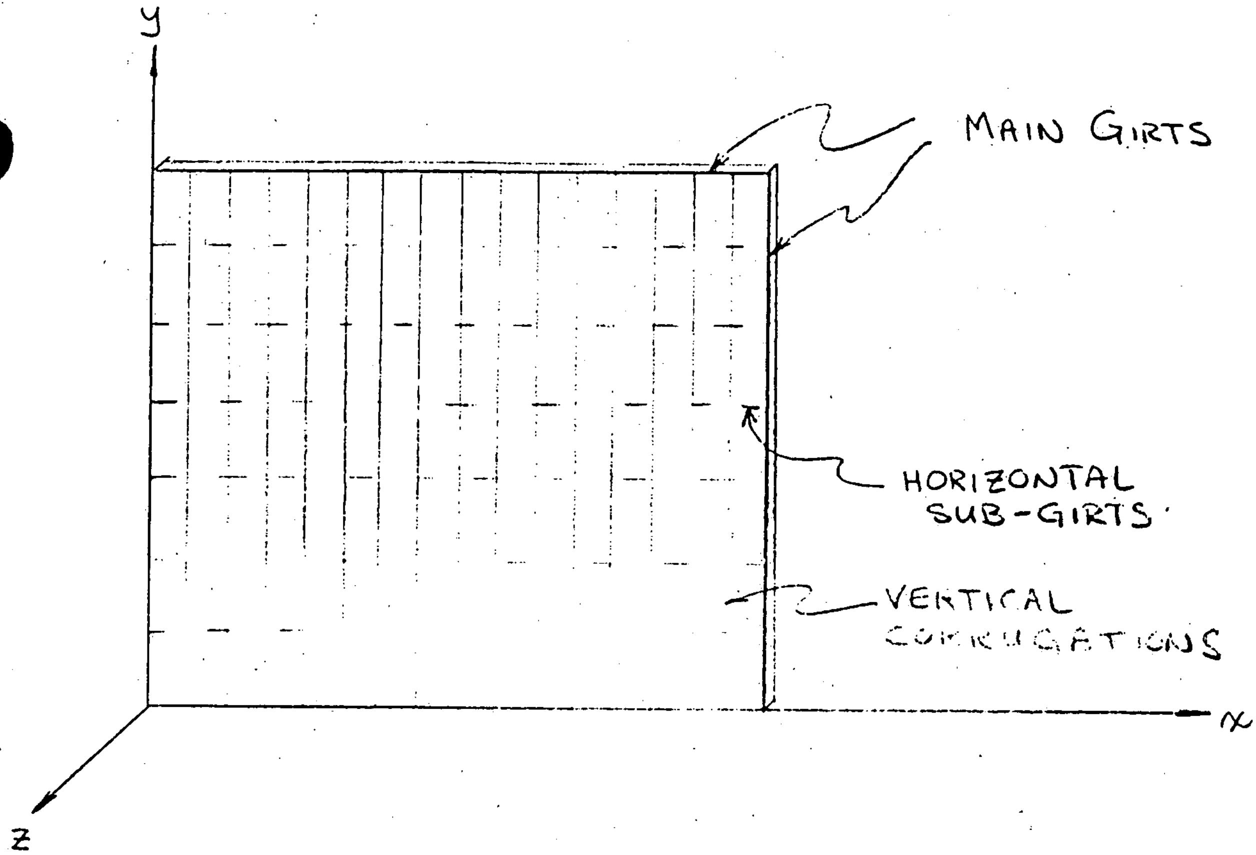
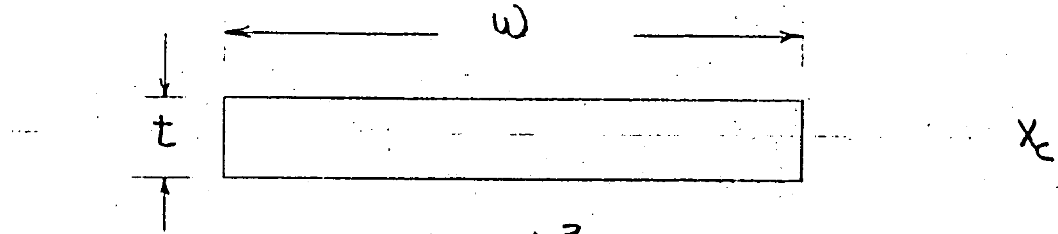
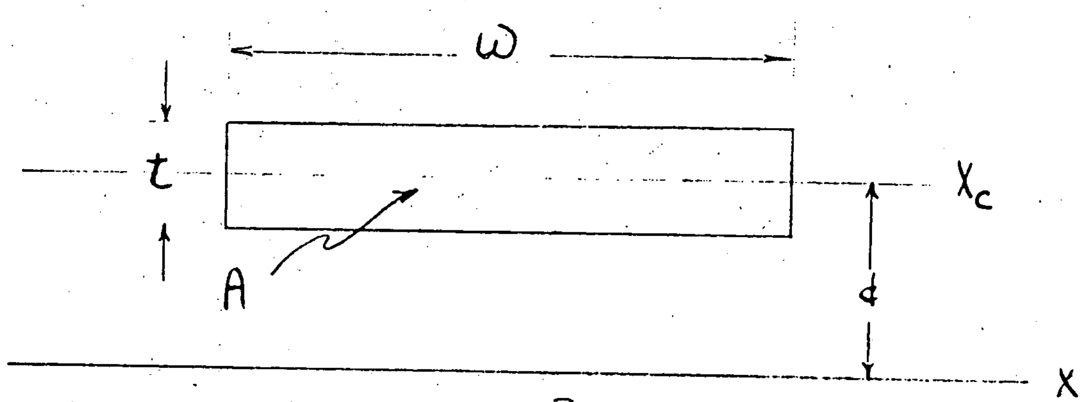


Figure A. Siding Section/Model Orientation



$$I_{x_c} = \frac{\omega t^3}{12}$$

Figure B. Moment of Inertia About Centroidal Axis.



$$I = I_{x_c} + Ad^2 = \frac{\omega t^3}{12} + \omega t d^2$$

Figure C. Moment of Inertia About Any Axis

$$Ix_{section} = Ix_L + Ix_f = 2.72678\ in^4 + 2.64506\ in^4$$
$$= 5.3718366\ in^4$$

For equivalent rigidity, the following must be true:

$$Ix_{plate} = \frac{wt^3}{12} = 5.3718366\ in^4$$

$$W = 24\ in.$$

$$t^3 = \frac{(5.3718366)\ 12}{24}$$

$$\therefore\ t = \sqrt[3]{2.6859183} = 1.39\ in.$$ equivalent thickness for steel plate (1.4 in. used in computer model).

Equal moments of interia will result in deflections being approximately equal under the same loading conditions.

A similar calculation for the moment of inertia about the y-axis yields:

$$Iy = 2.7353\ in^4$$
and $t = 1.11$ inches

The conservatism employed in the above calculation justifies the value chosen for the steel plate thickness.

3. Fasteners

The siding section is fastened to the main girts of the building. The fasteners used to hold the siding to the frame will be modeled as fixed support points spaced every 12 in. around the perimeter of the section, as recommended by the siding manufacturer. All axial (tensile or compressive) reaction loads must be carried through these Interface 1 fasteners. Shear forces, however, would be distributed to the Interface 2 and 3 fasteners, proportionally to the number of other fasteners and the deflections at the attachment points. This computer model does not account for shear force distribution. In this model, all shear forces will be carried by the Interface 1 fasteners. However, an approximation on the actual distribution can be made to calculate the shear force on the Interface 1 fasteners.

3. Fasteners (cont'd)

An additional consideration which offsets some of the uncertainty in the above shear force approximation is the elimination of all body force (weight) loads on the fasteners. The actual weight of a panel section is:

Liner	- 1.78128 lb/ft^2
Cover	- 1.81902 lb/ft^2
Subgirts	- "few" oz/ft^2
Fasteners	- "few" oz/ft^2
Insulation	- "few" oz/ft^2
Total	_ 3.6003 lb/f^2 "few oz" $\cong$ 4.0 lb/ft^2

The siding section under examination is:

Height - 19 ft.
Width - 21 ft. 8 in.

Area = 411.67 ft^2

Total load = (411.67) (4) = 1646.67 lbs.

If distributed evenly over the 82 Interface 1 fasteners, this results in a shear force of 20 lbs/fastener. Neglecting this load is conservative because it allows the fasteners (Interface 1) to withstand a higher pressure load before reaching the ultimate strength of the fastener or liner.

4. The Model

Our solution uses a finite element analysis to calculate the forces, stresses and displacements throughout the section. A Quality Assured (QA) computer software program, GTSTRUDL, performs the analysis as described in Section II of this report.

The finite element model consists of a thin plate oriented in the x-y plane of a Cartesian coordinate system. The origin is defined as the lower, left-hand corner of the section being analyzed; all dimensions in the model are in inches and are positive. The plate is divided into 418 finite elements and 460 nodes or joints numbered consecutively from left to right and bottom to top. The nodes are located at 12 inch intervals starting from the origin and proceeding in the +x and +y directions (fastener locations). This results in a Nodal mesh of 23 columns and 20 rows; the element matrix contains 22 columns and 19 rows. All elements, except for column 22, are 12 inches square. The last column contains elements which are 8 inches by 12 inches. All elements are 1.4 inches thick and have constant material properties; namely, Modulus of Elasticity = 30 x 10^6 psi and Poisson's Ratio = 0.3.

4. The Model (cont'd)

GTSTRUDL contains a library of possible finite elements which can be selected in developing the finite element model. Finite elements for plane stress/plane strain, plate bending, etc. are available. Two or three dimensional elements can be used. The emphasis of this analysis is to calculate the reaction forces in the fasteners at each joint; therefore, a simple, rectangular plate bending element was chosen. (GTSTRUDL element library type "BPR".) This is a two-dimensional element which uses the element thickness to calculate element rigidity. Joint displacement at the supports was not permitted so that pressure loads would produce maximum stresses.

IV. Data Reduction

To determine what pressure load will cause failure, it is necessary to analyze 4 areas:

1. reaction forces at supports (fasteners) (lbs)
2. shear loads at supports (lbs/in)
3. shear loads at center joints (lbs/in)
4. displacements at center joints (in)

Failure (pull-over) will occur at a reaction force greater than 1500 lbs, as stated by the manufacturer. Severe deflections ($\geq$ 6 inches at the center) will signify pull-out of local fasteners. For support fasteners (Interface 1) shear out failure will occur if the resultant shear load, Vxx or Vyy (see printout) exceed the material limit. For steel,

$$\sigma_{ultimate} = 60{,}000 \text{ psi}$$

$$\tau_{ultimate} = 0.577\,\sigma_{ultimate} = 34620 \text{ psi}$$

$$\tau_{ultimate} = (V_{ultimate})(A_{shear})$$

$$\frac{\tau_{ultimate}}{A_{shear}} = V_{ultimate}$$

$$\frac{\tau_{ULT}}{(\pi)\left(\frac{\text{Diameter Fastener}}{2\text{ (loaded area)}}\right)(\text{Plate Thickness})} = V_{ultimate}$$

$V_{ultimate}$ is in lbs. The computer results are in lbs/in. and there are 12 inches in each element perpendicular to one of the four plate edges. This yields:

$$V_{xx} \text{ or } V_{yy} = 101.68\ \frac{\text{lbs}}{\text{in.}}$$ (maximum allowable before shear-out failure occurs).

V. Results and Interpretation

Enclosure 2 contains the results of the GTSTRUDL finite element analysis. The forces, moments, stresses and displacements have been calculated for four loading conditions: 30, 60, 90 and 200 PSF. The forces on each of the Interface 1 fasteners are a combination of the axial (+2 direction) forces due to the pressure load, shear forces due to weight (-y direction, not modeled), and shear forces due to plate bending at the particular point on the plate ($\pm x$, $\pm y$ directions).

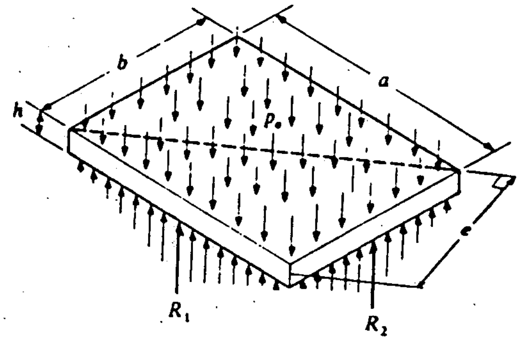
As the results show, the model closely predicts the analytical solution (Ref. 1, pg. 133-138) for a simply supported rectangular plate. Notice that the corners of the plate tend to curl up as is predicted in the analytical solution. This phenomenam can be seen in the results of the analysis as a change in sign in the reaction forces around the corners of the plate.

The analytical solution presented in Reference 1 predicts a maximum bending stress of:

$$\sigma_{max} = \frac{P_o a^2 b^2}{2h^2 (a^2+b^2)} \quad \text{(see figure D)}$$

A numerical solution using the complete thin-plate equations converges to a maximum bending moment which is approximately 15% greater than the analytical solution. The numerical solution of reference 1 is in good agreement with the results obtained using GTSTRUDL.

The pressure loads on the plate produce reaction forces which act axially on the fasteners. Table 1 summarizes the reaction forces for fasteners located at each mid-span (joints 12, 231, 253, 449) and the joint with the highest bending moment (joint 184). The manufacturer's data states that pull-over occurs at 1500 lbs. at Interface 1. The results show that significant (25%) pull-over (shear in +Z direction) occurs at 200 PSF. At the same pressure load, more than half of the fasteners will experience shear out (shear in $\pm x$, $\pm y$ direcitons) as shown in Table 2.



(a)

Figure D. Schematic Model

Table 1. Pull-Over (Liner Shear; +Z direction)

Joint No.	Pressure Load, PSF	Reaction Force Lbs.
12	30	-272.06
184	30	-526.19
231	30	-260.69
253	30	-256.97
449	30	-272.49
12	60	-544.12
184	60	-1052.37
231	60	-521.39
253	60	-513.93
449	60	-544.98
12	90	-816.18
184	90	-1578.56
231	90	-782.08
253	90	-770.90
449	90	-817.47
12	200	-1632.36
184	200	-3157.12
231	200	-1564.16
253	200	-1541.79
449	200	-1634.93

Table 2. Shear-Out (Liner Shearing; ±x, ±y directions)

Joint No.	Pressure Load, PSF	Shear Load Vxx, lbs/in.	Shear Load Vyy, lbs/in.
12	30		20.86
184	30	42.94	
231	30	19.78	
253	30	-19.46	
449	30		-20.91
12	60		41.72
184	60	85.88	
231	60	39.55	
253	60	-38.93	
449	60		-41.82
12	90		62.59
184	90	128.82	
231	90	59.32	
253	90	-58.39	
449	90		-67.73
12	200		125.18
184	200	257.65	
231	200	118.66	
253	200	-116.79	
449	200		-125.45

V. Results and Interpretation (cont'd)

Similar shear failures will occur on the plate interior as deflections become dramatic as the plate center begins to bulge. GTSTRUDL considers only elastic situations and, therefore, the plastic deformation which would occur is not show. Table 3 provides deflection data at joints near the center of the plate.

Failure of the plate will occur at a pressure load of 1.26 psi which is less than 200 PSF (1.4 psi). The nature of the failure is most probably a combination of the following:

1. liner pull-over along supports.
2. liner shear-out along supports.
3. liner shear-out at internal fasteners.
4. fastener pull-out at internal fasteners.

The predominant failure mode will be a combination of Items 1 and 2 and could be catastrophic in nature depending on the time period in which the plate is loaded. However, a quasi-static loading would still produce a "zipper" effect failure.

Table 3. Shear Load and Displacements at Plate Center

Joint	Pressure Load PSF	Vxx (lbs/in)	Vyy (lbs/in)	Displacement +Z, in.
170	30	1.81	4.44	0.09
175	30	-2.31	4.68	0.10
285	30	1.84	-2.86	0.09
290	30	-2.16	-2.89	0.10
170	60	3.62	8.87	0.19
175	60	-4.61	9.36	0.20
285	60	3.64	-5.73	0.19
290	60	-4.33	-5.99	0.20
170	90	5.43	13.3	0.28
175	90	-6.91	14.03	0.29
285	90	5.46	- 8.59	0.28
290	90	-6.49	- 8.98	0.29
170	200	10.85	-26.61	0.56
175	200	-13.83	28.07	0.59
285	200	10.91	-17.18	0.56
290	200	-12.98	-17.97	0.59

Note: Bending moments increase as the geometric center is approached.

VI. Conclusions

The results of this analysis indicate that the building siding will start to fail at 0.42 psi and at a pressure load of 1.26 psi the panel will fail completely. The exact failure mode cannot be accurately defined. Only a few general hypotheses about failure modes can be made based on the results of the analysis and assumptions made in generating the computer model; namely,

- uniformly distributed pressure load.
- all fasteners are the same.
- perfect construction (no eccentricities).
- no support displacements.
- totally elastic deformations.

With these assumptions noted, the conclusion of this report is that the PLASTEEL C-3 siding section will fail by a combination of liner material shearing and fastener pull-out to an extent which relieves the pressure (1.26 psi) load which caused the failure.

It should be emphasized, however, that the main steam lines run adjacent to the siding panels throughout the building. A failure of a main steam line will result in siding panel failure through direct steam impingment upon the panels long before pressure in the building increases to the 1.26 psig value discussed above.

The saturation temperature associated with 0.42 psig is 213^{o}F. The saturation temperature associated with the peak pressure of 1.26 psig is 216^{o}F. The difference between 213^{o}F and 216^{o}F (viz 3^{o}F) has no effect on the qualification of equipment in the steam and feedline penetration area because the equipment is qualified for temperature in excess of 250^{o}F and pressures in excess of 40 psig.

VII. References

1. Budynas, R. G., Advanced Strength and Applied Stress Analysis, McGraw-Hill Book Company, c 1977.

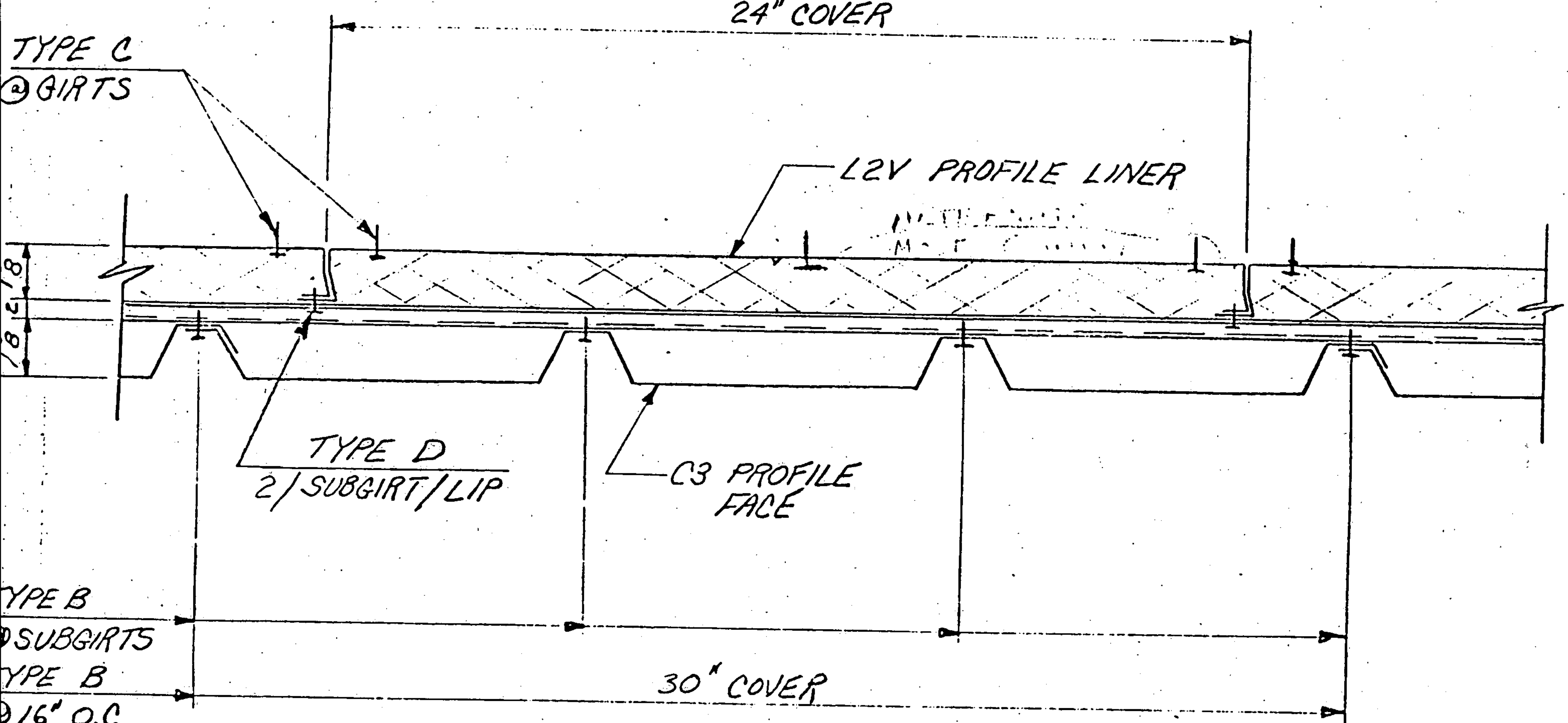
2. Manual of Steel Constuction, American Institute of Steel Construction (AISC), 7th Edition, c 1973.

3. Byars, E. F. and Snyder, R. D., Engineering Mechanics of Deformable Bodies, 3rd Edtion, Intext Educational Publishers, c 1975.

4. Emkin, L., Will, K., et. al., GTSTRUDL USER INFORMATION MANUAL, Second Edition, Report No. SCEGIT-79-179, Georgia Institute of Technology, January 1979.

ENCLOSURE 1

PLASTEEL PRODUCTS CORPORATION
SUPPLIED INFORMATION

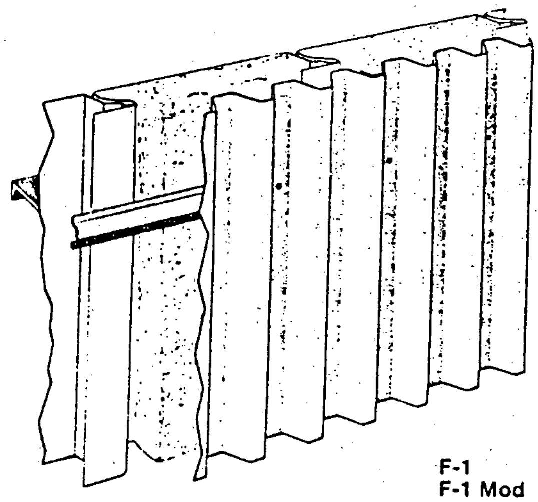


PLASTEEL PRODUCTS CORPORATION

ORDER NO. 0-PE-110

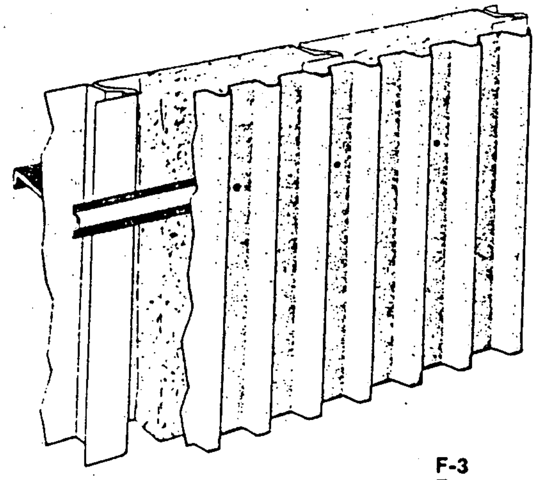
BY	DATE	DWG. NO.
MB	5-17-84	L2V-C3

Plasteel Insulated Wall Systems   Type 21 (Span Charts)



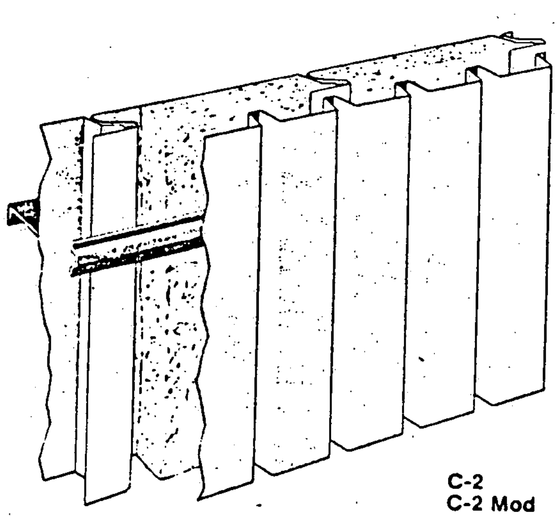
F-1
F-1 Mod

		STEEL FACIA				ALUMINUM FACIA		
		24ga	22ga	20ga	18ga	20ga B/S	18ga B/S	16ga B/S
LINERS 12"	24	8'-9	9'- 4	10'- 0	10'-11	7'-5	7'-10	8'- 3
	22	9'-0	9'- 8	10'- 2	11'- 2	7'-9	8'- 2	8'- 7
	20	9'-4	9'-11	10'- 5	11'- 4	8'-2	8'- 6	8'-11
	18	10'-0	10'- 5	10'-11	11'- 9	9'-0	9'- 3	9'- 7
	22	8'-6	9'- 2	9'- 9	10'- 9	7'-0	7'- 5	8'- 0
	20	8'-8	9'- 3	9'-10	10'-11	7'-3	7'- 8	8'- 2
	18	9'-0	9'- 7	10'- 2	11'- 2	7'-9	8'- 2	8'- 7



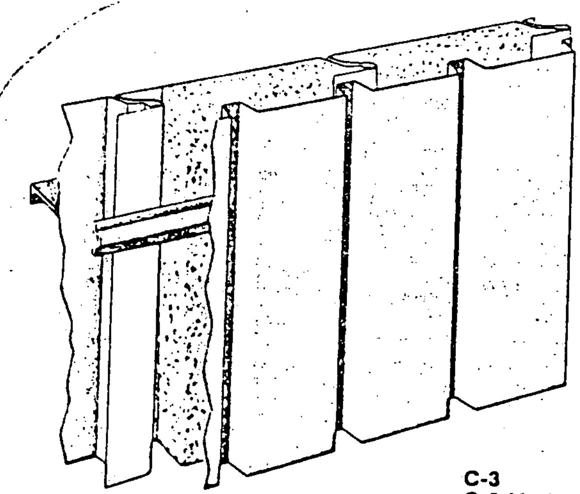
F-3
F-3 Mod

		STEEL FACIA				ALUMINUM FACIA		
		24ga	22ga	20ga	18ga	20ga B/S	18ga B/S	16ga B/S
STEEL LINERS 12"	24	7'- 1	7'-5	7'-9	8'-4	6'- 5	6'-7	6'-10
	22	7'- 6	7'-9	8'-1	8'-8	6'-11	7'-1	7'- 4
	20	7'-11	8'-2	8'-6	9'-0	7'- 5	7'-7	7'- 9
	18	8'- 9	9'-0	9'-5	9'-8	8'- 4	8'-6	8'- 7
STEEL LINERS 24"	22	5'- 9	7'-0	7'-4	8'-0	5'-10	6'-1	6'- 5 -
	20	6'-11	7'-3	7'-7	8'-3	6'- 3	6'-6	6'- 8
	18	7'- 6	7'-9	8'-1	8'-8	6'-11	7'-1	7'- 4



C-2
C-2 Mod

		STEEL FACIA				ALUMINUM FACIA		
		24ga	22ga	20ga	18ga	20ga B/S	18ga B/S	16ga B/S
STEEL LINERS 12"	24	9'- 3	10'-0	10'- 9	11'-11	7'-9	8'- 2	8'- 9
	22	9'- 6	10'-3	10'-11	12'- 1	8'-1	8'- 6	8'-10
	20	9'-10	10'-6	11'- 2	12'- 3	8'-6	8'-10	9'- 5
	18	10'- 5	11'-0	11'- 7	12'- 8	9'-2	9'- 7	10'- 0
STEEL LINERS 24"	22	9'- 0	9'-0	10'- 6	11'-10	7'-4	7'-10	8'- 6
	20	9'- 2	10'-0	10'- 8	11'-11	7'-7	8'- 1	8'- 8
	18	9'- 6	10'-3	10'-11	12'- 1	8'-1	8'- 6	9'- 1



C-3
C-3 Mod

		STEEL FACIA				ALUMINUM FACIA		
		24ga	22ga	20ga	18ga	20ga B/S	18ga B/S	16ga B/S
STEEL LINERS 12"	24	7'-8	8'- 2	8'- 8	9'-6	6'-9	7'- 0	7'- 5
	22	8'-0	8'- 6	8'-11	9'-9	7'-3	7'- 6	7'-10
	20	8'-5	8'-10	9'- 3	10'-0	7'-8	7'-11	8'- 2
	18	9'-2	9'- 6	9'-10	10'-7	8'-7	8'- 9	9'- 0
STEEL LINERS 24"	22	7'-3	7'-10	8'- 4	9'-4	6'-3	6'- 7	7'- 0
	20	7'-6	8'- 0	8'- 6	9'-5	6'-7	6'-10	7'- 3
	18	8'-0	8'- 6	8'-11	9'-9	7'-2	7'- 5	7'- 9

NOTES: Allowable spans shown are simple spans. Contact Plasteel sales representative for information concerning continuous spans.
Allowable spans based on 20 PSF wind load and L/180 allowable deflection.
Spans shown are for equal inward and outward loads, may be increased in particular instance please consult.

FASTENER STRENGTH

PULL-OUT IN POUNDS						
PPC TYPE	1/4" PLATE	16 Ga	18 Ga	20 Ga	22 Ga	24 Ga
B Point	2500					
A Point		875	500	400	300	200

NOTE: Double Thickness Multiply by 2.

PULL-OVER IN POUNDS						
Standard 5/8	----	3000	2000	1500	1200	800
1 1/8 Washer	----	----	2400	1900	1700	---

ALUMINUM PANEL	.050	.040	.030
Standard 5/8	800	700	600
1 1/8 Washer	1285	860	825

16: 6:47 5/17/84

PROJECT---INDIAN RIVER

A.I.S.I. SPECIFICATION--1980
DESIGN STRESS=20,000 P.S.I.
*****

STEEL FACE PANEL C3 .02990 GAGE

LINER PANEL L2 .03590 GAGE

MAIN GIRT SPACING= 5.FT. 0.IN.

SUB-GIRT SPACING= 4.FT. 0.IN.

DESIGN LOAD = 60.LB. PER SQ. FT.

INSULATED WALL

INTERFACE -1 (LINER TO MAIN GIRT)

PULL OVER LOAD PER FASTENER= 300.LB.
SAFETY FACTOR ON DESIGN= 5.00

INTERFACE-2 (SUB-GIRT TO LINER)

PULL OUT LOAD PER FASTENER= 240.LB
SAFETY FACTOR ON DESIGN= 3.33

INTERFACE-3 (FACE PANEL TO SUB-GIRT)

PULL OUT LOAD PER FASTENER= 200.LB
SAFETY FACTOR ON DESIGN= 2.50

15:46: 4   5/17/84

PROJECT---INDIAN RIVER

A.I.S.I. SPECIFICATION--1980
DESIGN STRESS=20,000 P.S.I.
*****

SECTION PROPERTIES

STEEL SECTION L2   ----- .03590 GAGE

NORMAL------------ 2
NO. OF PITCHES--- 1
LAP NUMBER------- 1
G-LAP------------ .23400
H-LAP------------ .37500
PITCH------------ 24.00000
TOP FLANGE------- 23.68999
BOTTOM FLANGE---- .00000
DEPTH------------ 1.50000
RADIUS(TOP)------- .12500
RADIUS(BOTTOM)--- .12500

WEB----- 1.19010
ANGLE--- 83.76729
GIRTH--- 28.48866
GIRTH/PITCH--- 27.03056
LB./SQ.FT.---- 1.78128

POSITIVE

CWS-LOAD----- 20000.
POS-Y-L------- .15069
I-POS-L------- .06860
POS-S-L------- .04952
CS-IN--------- 660.
CWS-DEF------- 20000.
POS-Y-D------- .15069
I-POS-D------- .06860
POS-S-D------- .04952
CD-IN--------- 8994.

NEGATIVE

CWS-LOAD------ 11560.
Y-NEG-L------- .56257
NEG-I-L------- .04124
NEG-S-L------- .04237
CS-SUCTION--- 565.
CWS-DEF------ 9276.
NEG-Y-DEF---- .48664
I-NEG-DEF---- .04628
NEG-S-DEF---- .04411
CD-SUCTION--- 6068.

16:12:58 5/17/84

PROJECT---INDIAN RIVER

A.I.S.I. SPECIFICATION--1980
DESIGN STRESS=20,000 P.S.I.
*****

STEEL FACE PANEL C3 .02990 GAGE

LINER PANEL L2 .03590 GAGE

MAIN GIRT SPACING= 6.FT. 0.IN.

SUB-GIRT SPACING= 4.FT. 0.IN.

DESIGN LOAD = 60.LB. PER SQ. FT.

INSULATED WALL

INTERFACE -1 (LINER TO MAIN GIRT)

PULL OVER LOAD PER FASTENER= 360.LB.
SAFETY FACTOR ON DESIGN= 4.17

INTERFACE-2 (SUB-GIRT TO LINER)

PULL OUT LOAD PER FASTENER= 240.LB
SAFETY FACTOR ON DESIGN= 3.33

INTERFACE-3 (FACE PANEL TO SUB-GIRT)

PULL OUT LOAD PER FASTENER= 200.LB
SAFETY FACTOR ON DESIGN= 2.50

15:41:31 5/17/84

PROJECT---INDIAN RIVER

A.I.S.I. SPECIFICATION--1980
DESIGN STRESS=20,000 P.S.I.

*****

COMBINATION SIDING PANEL

STEEL FACE PANEL C3 .02990 GAGE

STEEL LINER PANEL L2 .03590 GAGE

DEFLECTION LIMIT=L/ 180.

POSITIVE LOAD= 60. LB./SQ.FT.
NEGATIVE LOAD= 60. LB./SQ.FT.

SAFE SPANS FOR SIDING
(O.TO C. OF 4.IN. GIRT)

SINGLE SPAN = 5. FT. 10.IN.

DOUBLE SPAN = 5. FT. 10.IN.

TRIPLE SPAN = 6. FT. 6.IN.

NEG. CORNER LOAD = 80. LB./ SQ. FT.

SAFE CORNER SPANS

SINGLE SPAN = 5. FT. 11.IN.

DOUBLE SPAN = 5. FT. 1.IN.

TRIPLE SPAN = 5. FT. 8.IN.

15: 0: 8   5/17/84

PROJECT---INDIAN RIVER

A.I.S.I. SPECIFICATION---1980
DESIGN STRESS=20,000 P.S.I.
*****

SECTION PROPERTIES

STEEL SECTION C3 ----- .03590 GAGE

NORMAL-------------	1
NO. OF PITCHES---	3
LAP NUMBER--------	1
G-LAP-------------	.21900
H-LAP-------------	.40600
PITCH-------------	10.00000
TOP FLANGE--------	7.12500
BOTTOM FLANGE-----	1.12500
DEPTH-------------	1.31200
RADIUS(TOP)-------	.37500
RADIUS(BOTTOM)----	.15625

WEB------	.99938
ANGLE---	69.98116
GIRTH---	36.36534
GIRTH/PITCH---	11.63420
LB./SQ.FT.----	1.81902

POSITIVE

CWS-LOAD-----	15074.
POS-Y-L-------	.57928
I-POS-L-------	.08979
POS-S-L-------	.11682
CS-IN---------	1558.
CWS-DEF-------	12653.
POS-Y-D-------	.52230
I-POS-D-------	.09938
POS-S-D-------	.12038
CD-IN---------	13030.

NEGATIVE

CWS-LOAD-----	20000.
Y-NEG-L-------	.34589
NEG-I-L-------	.12907
NEG-S-L-------	.12882
CS-SUCTION---	1718.
CWS-DEF-------	20000.
NEG-Y-DEF----	.34589
I-NEG-DEF----	.12907
NEG-S-DEF----	.12882
CD-SUCTION---	16923.

ENCLOSURE 5 TO IPN-84-63

JUSTIFICATIONS FOR CONTINUED OPERATION

NEW YORK POWER AUTHORITY

INDIAN POINT 3 NUCLEAR POWER PLANT

DOCKET NO. 50-286

EQUIPMENT TYPE: LEVEL SWITCH

MANUFACTURER: GEMS MODEL LS1900

FUNCTION: CONTAINMENT SUMP LEVEL INDICATION (LT 938, 939, 940, 941)

LOCATION: CONTAINMENT

DISCUSSION

The Gems Model LS1900 level switches are installed in the reactor containment sumps. These level switches have no control function but do provide information to the control room operators on the containment sump level. Franklin Research Center (FRC) has issued a Technical Evaluation Report (TER-C5257-456) which discussed the Gems level switches. FRC assigned the level switches to category Ib, Equipment Qualification Pending Modification.

QUALIFICATION DEFICIENCY

Documented evidence of qualification.

JUSTIFICATION FOR CONTINUED OPERATION

The operators have the ability to verify the level provided by the Gems level switches against that provided by the qualified Barton model 764 level transmitters (LT-1253 and 1254), which were installed to measure containment water level per NUREG-0737. This verification will determine if the Gems level switches have failed. As such, the operators will not be misled in the event of a failure of the Gems level switches.

Failure of the Gems level switches will not affect other safety-related equipment because they have no control function and are not connected to other safety-related equipment in containment.

Therefore, continued operation is justified.

FINAL RESOLUTION

The Authority considers that sump level switches can provide useful information to operating personnel. Therefore, either bistables will be incorporated into the circuits for the containment water level transmitters or the Gems switches will be replaced with qualified units.

EQUIPMENT TYPE: RESISTANCE TEMPERATURE DETECTOR

MANUFACTURER AND MODEL: SOSTMAN 11901B

FUNCTION: WIDE RANGE REACTOR COOLANT TEMPERATURE MEASUREMENTS (TE-413 A, B; TE-423 A, B; TE-433 A, B; TE-443 A, B)

LOCATION: CONTAINMENT

DISCUSSION

The Sostman RTD's are used to measure reactor coolant system cold leg and hot leg temperatures over the range between 70 F and 650 F. They are identified as the wide range reactor coolant system temperature detectors.

The wide range reactor coolant system temperature detectors provide information to the operators on post-accident temperatures. In particular from the hot leg detectors, the operators can determine the core outlet temperature. The cold and hot leg temperature detectors can also be used to infer RHR flow during the post-accident cool down phase.

DEFICIENCIES

Aging, peak temperature and radiation.

JUSTIFICATION FOR CONTINUED OPERATION

The only feasible failure modes for the RTD's are either an open circuit or a ground. Either failure mode results in zero reading which would tell the operators that the unit had obviously failed and could not be used to monitor temperature.

The operator also has backup temperature measurements from the core exit thermocouples and qualified narrow range RTDs. Although the thermocouples are not safety grade equipment, they are simple devices and do not require a power source.

The wide range RTD signals are incorporated in the Overpressure Protection System (OPS) logic. The OPS serves to prevent reactor vessel overpressurization at low temperatures (<350 F). A pressurizer power-operated relief valve (PORV) trip open condition will be initiated if two-out-of-three OPS channels sense an overpressure condition. The failure of two wide range RTDs at pressurized conditions could result in the opening of the

PORVs. The operator can use RCS pressure and backup temperature (core exit thermocouples and narrow range RTDs) measurements to determine if the PORV trip open signal was spurious. Corrective action would be to close the PORV block valves.

The testing on the Sostman RTD's reported in WCAP-9157 was extensive and no failures were reported. The LOCA simulation included testing at 340 F and 66 psi which envelopes the Indian Point Unit 3 conditions. Irradiation was to 10^8 rad. The post-accident 1 year dose for Indian Piont Unit 3 is less than 2 x 10^7 rads. The normal full power dose rate at the RTD is less than 500R/hr. This would indicate a lifetime of approximately 15 years and the ability to withstand the post-accident dose of 2 x 10^7 rads. Therefore, there is a high degree of confidence that the RTD's will function as required.

Since the only failure modes would be immediately obvious to other operators (no reading), failure of any individual instrument would not mislead the operators.

Therefore, continued operation is justified.

FINAL RESOLUTION

The Sostman RTD's will be replaced with fully qualified RdF units.

EQUIPMENT TYPE: FLOW, PRESSURE, AND LEVEL TRANSMITTERS

MANUFACTURER: FOXBORO E11 AND E13 SERIES

FUNCTION: SI- Recirculation Flow (FT-945A,B); High Head SI Flow (FT-924A, 925, 926, 926A, 927, 980, 981, 982); Pressurizer Level (LT-459, 460, 461); Reactor Coolant Pressure (PT-402, 403) RHR Recirculation Flow (FT-946A, B, C, D) H_2 Recombiner Flow Pressurizer Pressure (PT-455, 456, 474) Steam Generator Level (LT-417A thru D, LT-427A thru D, LT-437A thru D, LT-447A thru D)

LOCATION: CONTAINMENT

DISCUSSION

The Foxboro E11 and E13 transmitters are used to measure pressure, level, and flow in safety-related systems inside containment. The transmitters are used to provide trip functions and to provide the operators with information used for emergency procedures.

QUALIFICATION DEFICIENCY

Test sequence and instrument accuracy.

JUSTIFICATION FOR CONTINUED OPERATION

Testing by Westinghouse was performed and documented in letter NS-PLC-5023 T. M. Anderson (Westinghouse) to E.G. Case (Nuclear Regulatory Commission) dated April 26, 1978. Foxboro Model E11 and E13 -DM-MCA with radiation resistant amplifier (this model transmitter is similar to the E13DH-MCA with radiation resistant amplifiers model) was the subject of the test. The irradiation exposure consisted of an integrated dose of 1.8 x 10^7 rads. The output of the test units experienced no change as a result of radiation exposure. The transmitters then underwent autoclave testing at the Westinghouse Forest Hills test facility. The profile consisted of chemical spray injection (1.140% boric acid and .17% sodium hydroxide) at the start of the test with a temperature rise to 320 F while maintaining 75 psig. At the end of the initial 20 minutes, the test conditions were gradually reduced to 220 F and held there for 5 1/2 days (equivalent to 4 weeks) before the first unit became inoperable and exceeded the ± 25% accuracy limit set for long term monitoring.

Foxboro performed environmental tests on the same type of transmitter and documented it in Report Q9-6005. The profile of the test consisted of steam at 318°F and 90 psig for one hour then decreasing to 228 F and 56 psi for an additional 12 hours. The output of the transmitter decreased by a maximum of 9.00% during the 318°F period and to 5.58% during the 228°F period.

In addition, the following tests were performed by Foxboro on a separate effects testing basis:

1. Irradiation testing of various type electronics amplifiers used in transmitters, Report T2-1075.

2. Irradiation testing of various electronics amplifiers used in transmitters, Report T3-1097.

3. Loss of coolant environment and chemical spray performed on various transmitters, Report T3-1013.

4. Loss of coolant environment without chemical spray, supplement to Report T3-1013.

5. Irradiation testing of gaskets used in transmitters, Report T4-6045.

6. Transmitter amplifier irradiation, Report T3-1068.

7. Oil bath transmitter test, Report T4-6061.

All of the above mentioned tests were performed at Franklin Institute Research Laboratory, except the supplement to Report T3-1013 which was performed by Foxboro.

The testing demonstrates that post-accident degradation of the transmitters is a slow, long term process. The transmitters can be expected to function reliably for accident mitigation and provide valid information to the operators. Therefore, continued operation is justified. However, since they perform a long term cooling monitoring function, they will be replaced with fully qualified units.

Although the testing performed involved separate effects tests, no degradation occurred at radiation levels comparable to the Indian Point Unit 3 conditions. Therefore, there is a high probability of operation.

Westinghouse has advised NRC of established accuracy requirements, in percent of span for short term (5 minutes) trip functions and long term (4 months) post-accident monitoring consistent with plant safety analysis as follows.

Allowable Accuracy Tolerances for In-Containment Transmitters Required to Mitigate or Monitor the Effects of Postulated Accidents

(Radiation and Environment)

Transmitter Function	Accuracy Short Term	(Percent of Span) Long Term
1. Pressurizer Water Level	N/A	±25
2. Steam Generator Pressure	+10	±10
3. Steam Generator Water Level (Narrow Range)	+10	±25
4. Steam Generator Water Level (Wide Range)	N/A	±25
5. Steam Flow	-10	N/A
6. Pressure-Reactor Coolant System (Wide Range)	N/A	±10
7. Containment Sump Water Level	±10	±25

The maximum errors determined from the Foxboro testing were -13% for pressure transmitters. (Report T3-1013) and -5.7% to +4% (Reports T3-1013 and T3-1097) for differential pressure transmitters. Report T3-1068 reported 2 failures at 76 MRad in which the output went to 0. It is therefore concluded that failure or errors due to accident conditions would not mislead the operators.

FINAL RESOLUTION

The transmitters will be replaced with qualified units.

was to 10^8 rad. The post-accident 1 year dose for Indian Point Unit 3 is less than 2×10^7 rads. The normal full power dose rate at the RTD is less than 500R/hr. This would indicate a lifetime of approximately 15 years and the ability to withstand the post-accident dose of 2×10^7 rads. Therefore, there is a high degree of confidence that the RTD's will function as required.

Since the wide range RTD's have no control function and since the only failure modes would be immediately obvious to the operators (no reading), failure of any individual instrument would not mislead the operators.

Therefore, continued operation is justified.

FINAL RESOLUTION

The Sostman RTD's will be replaced with fully qualified RdF units.

EQUIPMENT TYPE: MOTORIZED VALVE ACTUATOR

MANUFACTURER: LIMITORQUE

FUNCTION: RHR ISOLATION VALVES - 744
RCP COOLING WATER SUPPLY - 769 & 797

LOCATION: PIPE PENETRATION AREA

BACKGROUND

The Franklin Research Center has prepared and submitted to the NRC a Technical Evaluation Report (TER) titled "Review of Licensee's Resolution of Outstanding Issues From NRC Equipment Environmental Qualification Safety Evaluation Reports," dated June 9, 1982. The NRC used this TER to prepare a Safety Evaluation Report (SER), which was sent to the Authority by letter dated December 30, 1982. The SER requested that the Justification for Continued Operation be reviewed and revised for any equipment judged to have qualification deficiencies. This exhibit provides resolution of the concern identified in the SER.

QUALIFICATION DEFICIENCY

The deficiency identified in the TER is that documentation from the manufacturer identifying the applicable test reports and aging degradation is missing.

LOCATION AND SAFETY FUNCTION

These actuators are located outside containment in the Pipe Penetration Area. The safety function performed by these actuators is to open and close various valves to control the flow of fluids associated with RHR and Reactor Coolant Pump Cooling Systems.

JUSTIFICATION FOR CONTINUED OPERATION

These actuators have Class B insulation and are used outside of containment in the Pipe Penetration Area. The only harsh parameter in this location is 3.6 Mrad (max.) integrated nuclear radiation dose. None of the Limitorque test reports indicate that radiation dose of this relatively low magnitude would preclude the valves from performing their safety function. Further, the previous TER issued by FRC on April 6, 1981 states:

"FRC EVALUATION:

The Licensee has not established that the cited references are directly applicable to this equipment; this can be done only by obtaining a statement from Limitorque. However, from a general knowledge of this equipment and the fact that the Licensee states that only the radiation exposure increases significantly as a result of an accident, FRC believes that the Licensee will be able to demonstrate conclusively that this equipment is qualified.

FRC recommends that the Licensee review the vendor's data on aging for the electrical components in this equipment and make a conservative estimate of qualified life."

In addition, since these actuators have Class B insulation and their function is performed early in the accident, there is substantial assurance that the actuators will operate.

In view of the information presented above and because the only deficiencies identified were lack of written evidence of traceability to a specific test report and aging analyses, continued operation is justified.

RESOLUTION OF QUALIFICATION DEFICIENCY

The actuators on motor operated valves 744, 769 and 797 will be replaced with qualified units.

EQUIPMENT TYPE: FLOW TRANSMITTER

MANUFACTURER: ROSEMOUNT 1151

FUNCTION: MAIN STEAM FLOW
FT-419B; FT-429B;
FT-439B; FT-449B

LOCATION: CONTAINMENT

DISCUSSION

The Rosemount 1151 transmitters are used to measure flow in a safety related system inside containment. These transmitters are used to provide trip functions, and to provide information to the operators.

QUALIFICATION DEFICIENCY

The concern identified in the qualification report for these transmitters is that they need to be sealed to prevent the intrusion of moisture.

JUSTIFICATION FOR CONTINUED OPERATION

Qualification testing was performed on a Rosemont 1151 DP. The tested transmitters were from the same order as the installed units. This unit was sealed or encapsulated with RTV-21 silicone compound to prevent intrusion of moisture. It satisfactorily completed testing on May 21, 1984. The transmitter was preaged to an equipment life of 15 years, subjected to a radiation level of 1.53 Mrads and to steam and chemical spray for 1.5 hours. The transmitter maximum error was approximately - 6% which is within the allowable limits specified (-10%) by Westinghouse for the Main Steam Flow Transmitters.

These transmitters supply inputs into the Reactor Protection System and the Engineered Safeguards System. The Engineered Safeguards System actuation is a high steam line flow as sensed by 1 out of 2 transmitters on a steam line for 2 out of 4 steam lines coincident with a low average temperature signal or a low steam line pressure signal. This is to protect the plant from a main steam line break down stream of the main steam isolation valves.

The Authority at this time has sealed one train (Train A) of these transmitters consistent with the sealing performed as part of the qualification program. This will ensure that one transmitter on each steam line will be capable of operation independent of the environment that it is exposed to. It also must be noted that the protection provided by these transmitters will be accomplished before the environment reaches the extremes that could result from an accident condition. Subsequent failure of these transmitters would not affect any other safety-related equipment or mislead the operators.

Therefore, continued operation is justified.

FINAL RESOLUTION

The remaining transmitters will be sealed consistent with qualification reports or the transmitters will be replaced with qualified units.

EQUIPMENT TYPE:	SOLENOID OPERATED VALVE
EQUIPMENT MANUFACTURER:	LAURENCE MODELS 110114 and 12544W
FUNCTION:	PROVIDES AIR SUPPLY TO OPEN AND CLOSE THE MAIN STEAM ISOLATION VALVES
LOCATION:	STEAM AND FEEDLINE PENETRATION AREA

DISCUSSION

The Franklin Research Center has prepared and submitted to the NRC a Technical Evaluation Report (TER) titled "Review of Licensee's Resolution of Outstanding Issues From NRC Equipment Environmental Qualification Safety Evaluation Reports," dated June 9, 1982. The NRC used this TER to prepare a Safety Evaluation Report (SER), which was sent to the Authority by letter dated December 30, 1982. The SER and Appendix D of the TER identifies two equipment items for which the Authority's Justification for Continued Operation was judged to be inadequate. This exhibit provides resolution of the concern addressed in the SER.

QUALIFICATION DEFICIENCY

The concern identified in the TER for the Laurence SOV's is that qualification documentation was not available.

LOCATION AND SAFETY FUNCTION

This equipment is located in the Shield Wall Area at El. 43'0". This enclosure provides weather protection for the main steam and boiler feed piping. Sheet metal paneling similar to that used in other areas of the plant is fastened to stringers which are jointed to the structural steel. A steam line break will cause the panels to fail, allowing steam to escape to the building exterior and preventing further pressure buildup.

LOCATION AND SAFETY FUNCTION (cont'd)

High energy lines in this enclosure are the main boiler feed lines upstream and downstream of the check valves, main steam lines upstream and downstream of the main stop valves, and steam supply lines to the AFP turbine. Pipe whip restraints are provided for the seismic Class I portion of these lines where necessary to prevent damage to adjacent Class I steam or feedwater lines. Other safety-related equipment in the area are the main steam isolation and main steam relief valves.

Temperature buildup in the area would not be significant since the exterior wall siding would blow off almost immediately following a break. The main steam isolation valves (MSIVs) are signaled to close immediately upon steam line break.

Main steam isolation valve controls must function to isolate all main steam lines in the event of a full MSLB downstream of the stop valves. The MSIV control SOVs are protected by adequate distance from postulated breaks at locations downstream of the stop valves. Hence, the control circuits would have performed their function before any temperature effects could build-up to impair their operation. Failure of the solenoid would not affect other safety-related equipment or mislead an operator.

EQUIPMENT DESCRIPTION

The Laurence SOV's are part of a packaged operating system supplied with the main steam isolation valves (MSIVs). Figure 1 shows the configuration and provides a description of the system operation. Figure 2 shows schematically the power supplies for the solenoid valves, demonstrating that the redundant SOV's shown on Figure 1 are powered from separate buses, and that the system, therefore, is not subject to a single disabling failure.

Figure 3 is an assembly drawing of a Laurence SOV. The configuration corresponds to the supply valve of Figure 1. In normal operation the lever arm (A) is held in the open position by latch (B). The spring (C) holds one

EQUIPMENT DESCRIPTION (cont'd)

latch in position. In this configuration the solenoid is deenergized and the valve plug (F) is held off the seat against the force of spring (D). When the solenoid coil is energized the plunger (E) is pulled upwards, disengaging the latch (B) from the lever arm (A). Spring (D) then forces the valve plug (F) to the closed position.

The solenoid dump valves function similarly. The only difference is that the spring force causes the valve to open.

FAILURE MODE ANALYSIS

The only failures which would prevent the valves from performing their function (refer to Figure 3) are:

1) Failure of spring (D).
2) Open or short-circuit in solenoid coil or coil connections.
3) Binding or sticking between the lever (A) and latch (B).

1) Failure of Spring (D). The drawing (Figure 3) states that internal parts are type 303 stainless steel (viz., plug (D), spring (F) and washer (G)), and the fluid is air. At normal ambient temperatures, the corrosion of stainless steel in air is negligible. Operating experience with installed valves at Indian Point 3 for a period of about 6 years has shown no spring failures in 16 valves when periodically tested as required by the Technical Specifications. Even if the spring force should be reduced, the weight of the lever arm (A) and the direction of flow would provide the necessary force to move the valves to their proper positions.

2) Open or Short Circuit in Solenoid Coil or Coil Connections. The valve is normally deenergized and located in an area where the ambient temperature is 105°F (or less). Aging degradation of the Class H coil is negligible (rated for continuous duty at approximately 350°F). As

FAILURE MODE ANALYSIS (cont'd)

noted for the springs above, no failures or anomalies of the coilds or connections have been identified by the periodic testing required by the Technical Specifications. Random failure of a coil would not preclude system operation because the design is "single-failure-proof".

3) Binding or sticking between the lever are (A) and latch (B). If high friction from metal-to-metal contact between the latch and lever arm (or between the latch and the solenoid plunger) occurred, the coil force to cause valve actuation would increase. If friction forces resulted in binding, the solenoid would not produce sufficient force to actuate the valve. To preclude such events, the moving parts of the operating mechanism are periodically lubricated. They are also tested as required by the Technical Specifications to demonstrate operability.

As noted above, aging of the solenoid coil is not of concern. However, the Buna-N material used in the valve disc is subject to aging. Because there is no data available in the published literature for Buna-N as used in the SOV's, a qualified life cannot be established. Data on Buna-N seals (gaskets and "O" rings) have indicated lifetimes between 6 and 15 years at 135^{o}F. Since, in this valve application, the material is normally unstressed, engineering judgement would indicate that a life of 15 years (the upper bound for stressed materials) could be anticipated. If some degradation occurs it would not prevent the valve from shutting off the air supply, even if some seal leakage occurred. Even with seal failure the valves would operate. As noted above, periodic testing assures that no significant degradation has occurred.

It is, therefore, concluded that there is no credible failure mode that would prevent the valves from functioning.

JUSTIFICATION FOR CONTINUED OPERATION (Revised)

Continued operation is justified because:

1) There are no credible failure modes which would prevent the valves from operating.

2) Engineering judgement indicates that qualified life has not been exceeded.

3) The instrumentation that initiates protective action in the event of a steam line break is not exposed to the accident environment and will function to actuate the solenoids and trip the valves. The operating time from SOV actuation to MSIV closing is less than 5 seconds. This time is verified by periodic testing.

4) The temperature and pressure in the area where the solenoids are located would not significantly increase over ambient in the event of a steam line break before isolation of the break could occur.

5) The systems in which the valves are located are "single-failure-proof".

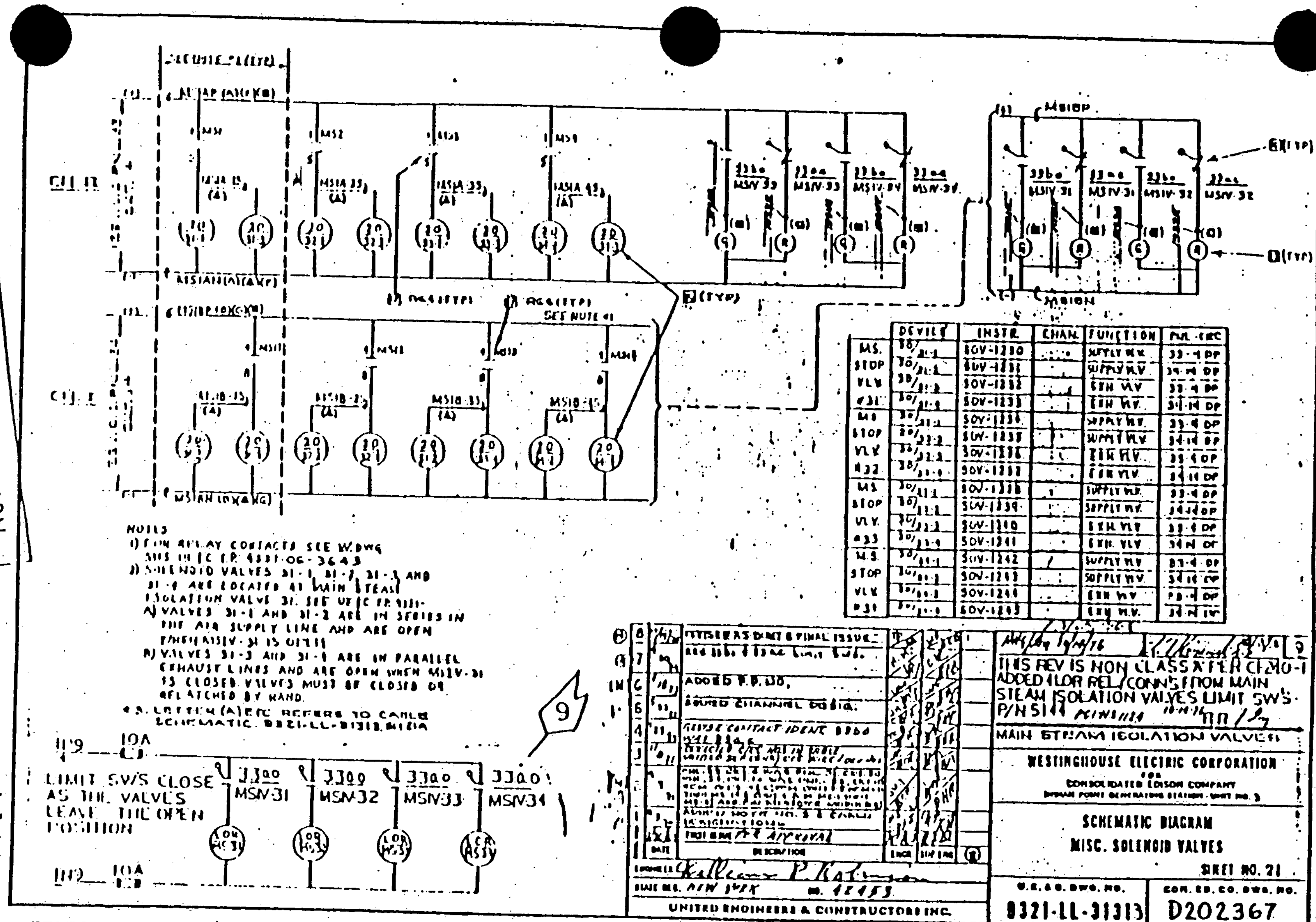
6) The only break that could affect the solenoids is a break in the piping upstream of the MSIV with which the SOVs are associated. Blowdown of other steam generators in such an event is prevented by the check valves installed in the main steam lines upstream of the MSIVs.

7) Valve failure after trip would not affect other safety-related equipment or mislead the operators.

RESOLUTION OF QUALIFICATION DEFICIENCY

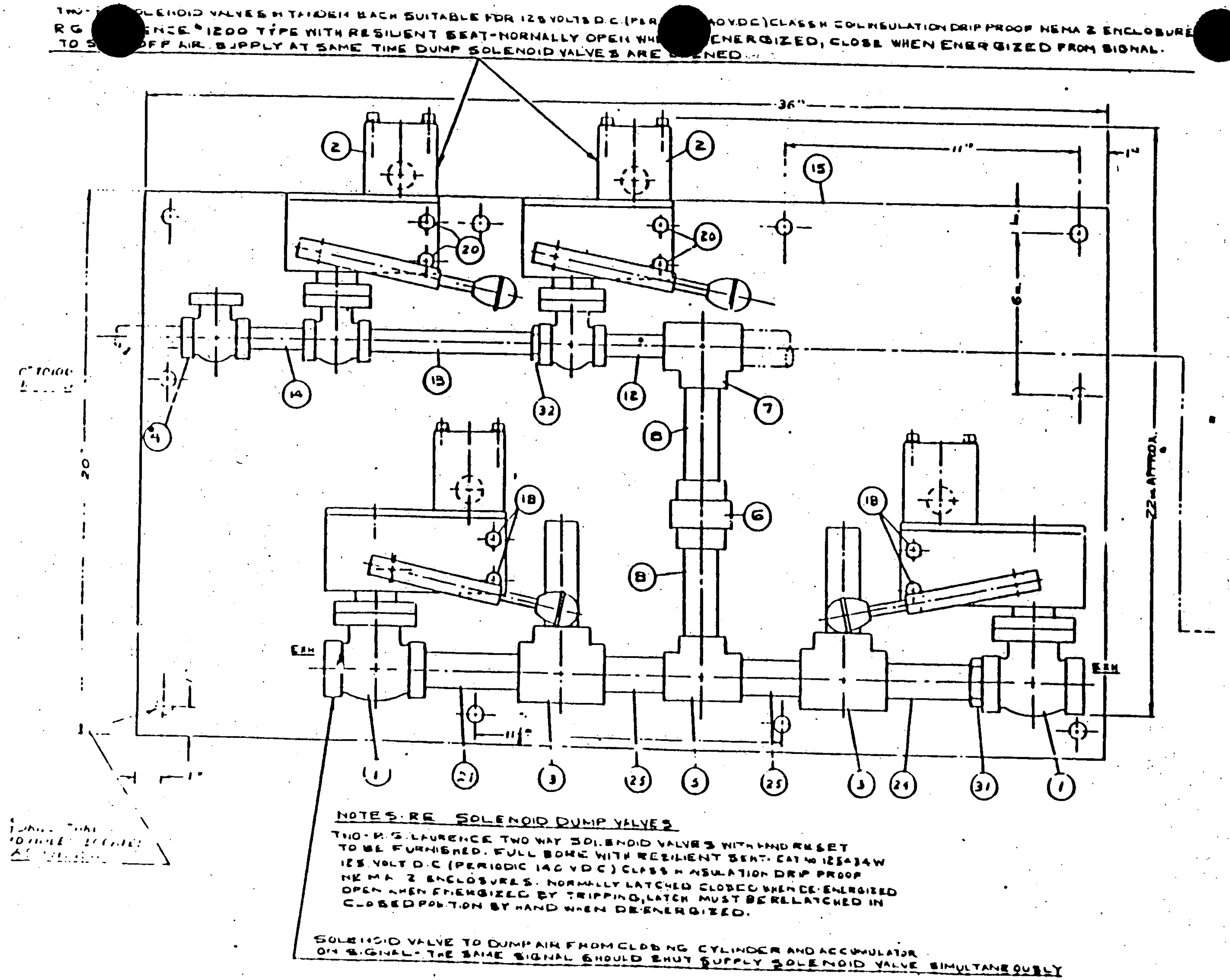
The valves will be replaced by qualified valves.

INFORMATION ONLY
Not For Installation



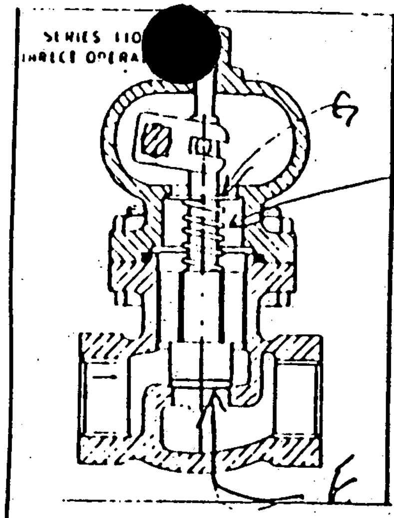
	DEVICE	INSTR.	CHAN.	FUNCTION	PNL-CKT
MS.	30/31-1	SOV-1230		SUPPLY VLV	33-4 OP
STOP	30/31-2	SOV-1231		SUPPLY VLV	34-14 OP
VLV	30/31-3	SOV-1232		EXH VLV	33-4 OP
#31	30/31-4	SOV-1233		EXH VLV	34-14 OP
MS	30/32-1	SOV-1236		SUPPLY VLV	33-4 OP
STOP	30/32-2	SOV-1235		SUPPLY VLV	34-14 OP
VLV	30/32-3	SOV-1236		EXH VLV	33-4 OP
#32	30/32-4	SOV-1237		EXH VLV	34-14 OP
MS	30/33-1	SOV-1238		SUPPLY VLV	33-4 OP
STOP	30/33-2	SOV-1239		SUPPLY VLV	34-14 OP
VLV.	30/33-3	SOV-1240		EXH VLV	33-4 OP
#33	30/33-4	SOV-1241		EXH VLV	34-14 OP
M.S.	30/34-1	SOV-1242		SUPPLY VLV	33-4 OP
STOP	30/34-2	SOV-1243		SUPPLY VLV	34-14 OP
VLV	30/34-3	SOV-1244		EXH VLV	33-4 OP
#34	30/34-4	SOV-1245		EXH VLV	34-14 OP

FIGURE 2



TWO- SOLENOID VALVES IN TANDEM EACH SUITABLE FOR 125 VOLTS D.C. (PER AC V.D.C.) CLASS H COIL INSULATION DRIP PROOF NEMA 2 ENCLOSURE
RG ENCE 1200 TYPE WITH RESILIENT SEAT-NORMALLY OPEN WH ENERGIZED, CLOSE WHEN ENERGIZED FROM SIGNAL.
TO S OFF AIR SUPPLY AT SAME TIME DUMP SOLENOID VALVES ARE NED
36"
11"
1"
6"
20
22" APPROX.
NOTES RE SOLENOID DUMP VALVES
TWO - R. S. LAURENCE TWO WAY SOLENOID VALVES WITH HAND RESET
TO BE FURNISHED. FULL BORE WITH RESILIENT SEAT. CAT No 125434W
125 VOLT D.C. (PERIODIC 140 V.D.C.) CLASS H INSULATION DRIP PROOF
NEMA 2 ENCLOSURES. NORMALLY LATCHED CLOSED WHEN DE-ENERGIZED
OPEN WHEN ENERGIZED BY TRIPPING, LATCH MUST BE RELATCHED IN
CLOSED POSITION BY HAND WHEN DE-ENERGIZED.
SOLENOID VALVE TO DUMP AIR FROM CLOSING CYLINDER AND ACCUMULATOR
ON SIGNAL - THE SAME SIGNAL SHOULD SHUT SUPPLY SOLENOID VALVE SIMULTANEOUSLY

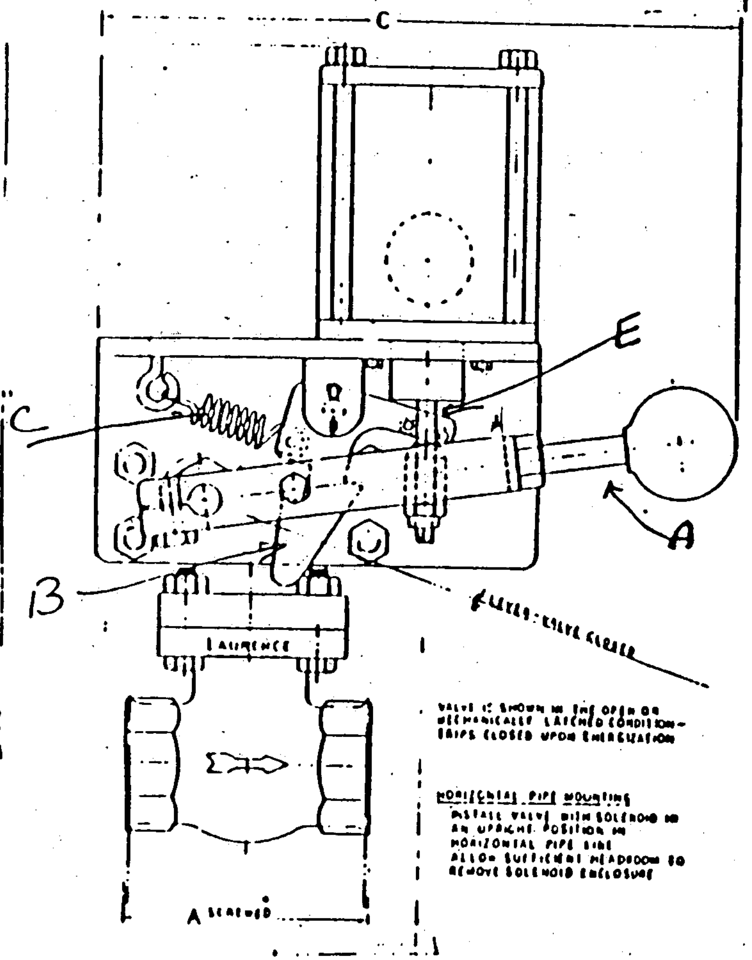
FIGURE 1

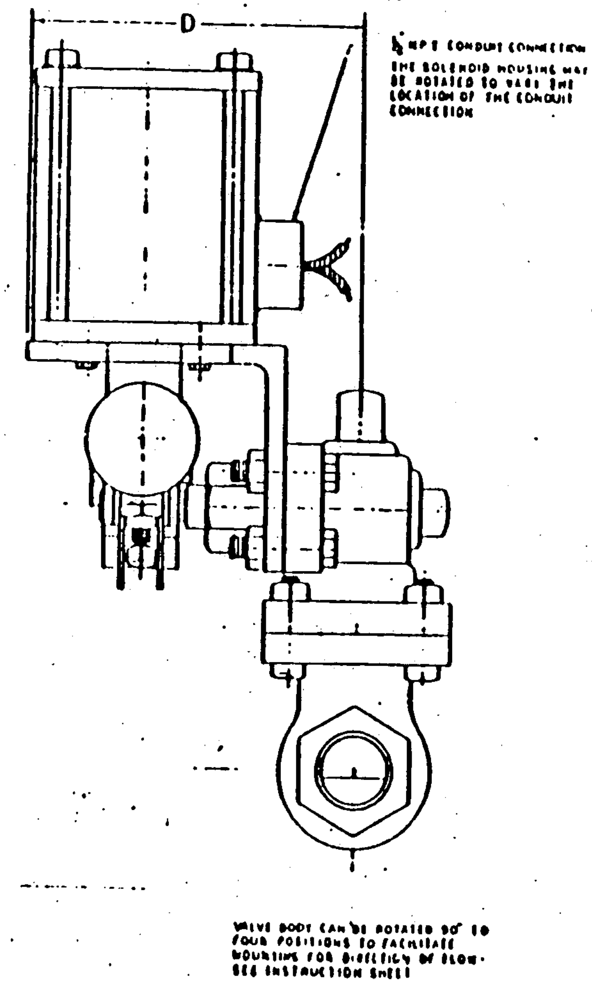


ITEM ______ TAG ______
MARK ______
CUSTOMER ______
P.O. ______ REQ ______
USER P. A. S. N. Y.
LOCATION INDIAN POINT #3

SERIES 1100
2-WAY MANUALLY RESET
ROTARY SHAFT SOLENOID VALVE
NORMALLY CLOSED-LATCH TO OPEN
ELECTRICALLY TRIPPED-TRIPS ON ENERGIZATION

( )LAURENCE CATALOG NO. 110114W
PIPE SIZE 1/2" $C_{V(APPR.)}$ 3.0 PORT DIA. 1/2"
VALVE TYPE DIRECT OPERATED
VALVE BODY BRONZE DISC BUNA-N
INNER PARTS TYPE 303 ST. STEEL
FLUID AIR ______ SPEC. GRAVITY ______
VISCOSITY ______
OTHER PROPERTIES ______
MAX OPENING PRESSURE DIFFERENTIAL 125 PSI
OPERATING TEMP'S ______ AMBIENT ______
FLOW RATE ______ ΔP ______
TYPE CONNECTIONS CL. 250 SCREWED
SOLENOID ENCLOSURE NEMA 2
125 VOLTS DC CONT. DUTY
COIL INSULATION CLASS H





DIMENSIONS (APPROX): A- 2 1/2" B- 8 3/4" C- 8"
D- 4 1/2" NET WEIGHT ______ LB

CURRENT DATA (APPROX): 0.2 AMPS HOLDING
0.2 AMPS INRUSH
AT 125 VOLTS, DC

REFER TO BULLETIN SERIES 1100
LAURENCE SERIAL NO. 21371-2
LAURENCE S.O. NO. 21371

FIG. NO. 1100-F2

R. G. LAURENCE CO. INC.
TENAFLY, N J 07670 U S A
PHONE: 201 568-6471

FIGURE 3

ENCLOSURE 6 TO IPN-84-63

MAINTENANCE AND SURVEILLANCE PROGRAM

NEW YORK POWER AUTHORITY

INDIAN POINT 3 NUCLEAR POWER PLANT

DOCKET NO. 50-286

Maintenance and Surveillance

The existing maintenance program at Indian Point Unit No. 3 has been based on information contained in The Manufacturers' Technical Manuals. These documents, however, do not contain specific information on age related degradation.

During the past year, aging analyses have been performed for the degradable materials in the safety-related equipment which could be exposed to harsh environmental parameters.

The results of the aging analyses will be used in conjunction with failure modes and effects analyses for the safety-related equipment and single failure analyses of the systems in which they are installed to determine whether:

1. Age related degradation can result in equipment failure or degrade equipment performance.
2. Common mode failure of redundant equipment could occur as a result of age related degradation.

Equipment and/or part replacement schedules will be determined from the analyses so that the equipment is maintained in a qualified state throughout its installed life.

It is recognized that aging analyses are "state of the art" and there is limited data establishing validity for all applications. Therefore, the aging analyses will be supplemented with actual performance (in similar or worst environments) of the same equipment used in fossil fueled power plants, petrochemical plants, heavy industry, and chemical plants to verify the effects of aging and to determine actual failure modes and failure rates.

Systematic monitoring and data diagnosis will be employed to evaluate the condition of equipment having degradable materials when the degradable property can be determined or directly inferred.